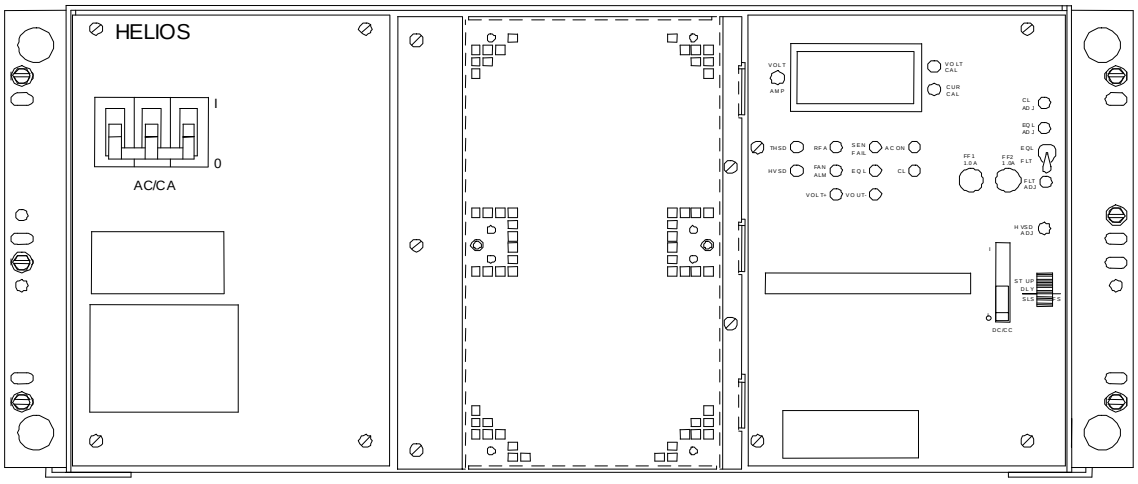
Emerson Energy Systems

UM5C05C (169-2081-501)

Helios Modular Switch Mode Rectifier 200I/48—NT5C05C

Installation and User Manual



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EMERSON
Network Power

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions contained in the Installation and User Manuals, can cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Publication history

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Standard Issue 6.00. Manual restructured and updated to reflect Emerson Energy Systems and Emerson Network Power identities. (ECN 102-26804)

March 1998

Issue 5.0. Standard. Reference change from NT5C05CB to NT5C05C.

July 1997

Issue 4.0. Standard EMI compliance information and table of content numbering corrections.

June 1995

Issue 3.0. Standard. Revised rectifier installation procedure in a cabinet.

September 1994

Issue 2.0. Standard. Few revisions and additions from the previous issue.

July 1994

Issue 1.0. Standard. Few changes from the previous issue and the document is now rated “Standard”

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Contents

List of Figures

List of Tables

List of Procedures

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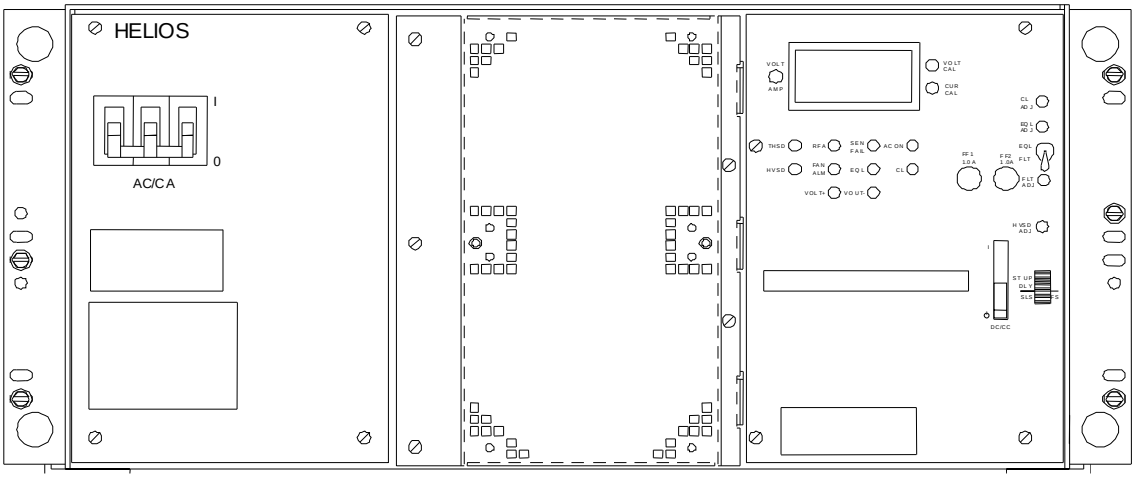
1. General information

1.1. Purpose of this manual

This manual provides installation, operation and maintenance information for the NT5C05CA / CB / CC 200I modular switch mode rectifiers with an input voltage of 380 / 415 V ac and an output capacity of 200 A at a nominal voltage of –48 volts. This manual covers all applications of the rectifier referred to as the 200I (“I” standing for “International”) market.

Figure 1 - Front view of the modular 200I / 48 switch mode rectifier



The NT5C05CA / CB / CC rectifiers are designed to operate continuously in a -48 V power system, equipped with or without batteries. It can be integrated into a small-embedded system or a larger power plant configuration. It is forced air-cooled by four fans contained in the unit, one of which is are redundant, if one fan fails this will not cause a shutdown of the rectifier. The rectifiers can be operated in conjunction with other Emerson rectifiers as well as with the models and conventional controllers of other manufacturers available on the market.

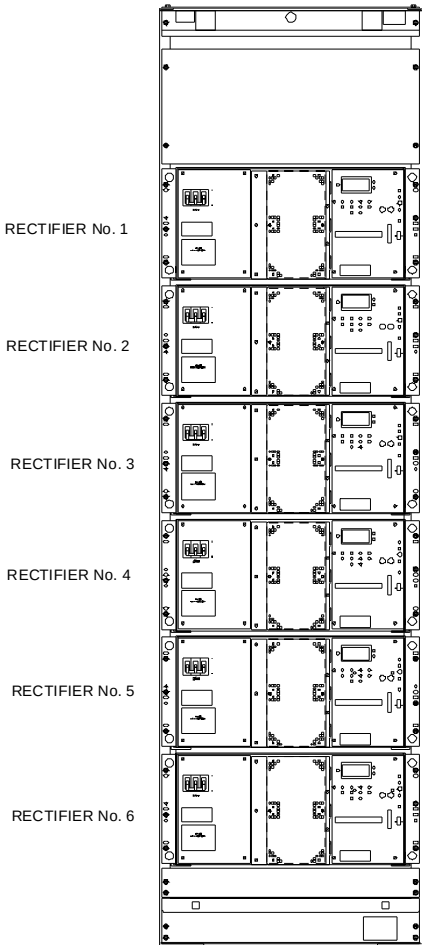
1.2. Models and mounting configurations

Two models of 200I rectifiers are available :

- Models NT5C05CA / CB, without an ac cable
- Model NT5C05CC, equipped with an ac cable terminated with a male plug

Up to six switch mode 200I rectifiers can be installed in a 23-inch NT6C43CB 1200 A cabinet or in an NT6C40 type frame. The cabinet is specifically designed to provide modularity within a very compact unit. For wooden floor applications in a zone 4 seismic region, up to three rectifiers can be installed in a mounting frame mounting, but they must be installed in the three lowest mounting positions in the frame.

Figure 2 - Typical mounting in a cabinet or frame



2. Specifications

2.1. Mechanical and electrical specifications

Table 1 - Mechanical specifications of the rectifier

Height :	10.0 inches (25.4 cm)
Depth :	22.0 inches (55.9 cm)
Width :	20.5 inches (52.1 cm)
Weight :	92.6 lbs (42 kg)

Table 2 - Electrical specifications of the rectifier

Input voltage :	Nominal : 380 / 415 V ac Range : 330 ±5 V ac to 475 ±5 V ac Frequency : 47 to 63 Hz ***Note:*** After an out of range line condition shutdown, the rectifiers will restart automatically at a line voltage within 350 ±5 V ac to 460 ±5 V ac.
Input current :	Nominal: 18 A RMS (at 415 V ac) Worst case: 24 A RMS
Input protection :	25 A ac breaker, 3 Ø
Output floating voltage :	–46 V dc to —58 V dc
Equalizing voltage :	0 to –4 V dc above the floating voltage
High voltage shutdown :	–52 V to –60 V dc
Output current :	200 A (330 to 475 V ac input)
Output protection :	200 – 250 A dc circuit breaker
Current limit :	50% to 105% of the rated output current

2.2. Operation specifications and ambient conditions

Table 3 - Operation specifications of the rectifier

Output regulation :	At the output terminals, the voltage is within ±0.5% of the set voltage value for all specified input and output variations, and within ±1% for any combination of specified input, output and ambient conditions.
Temperature drift :	Unless otherwise stated, all input and output parameters such as input voltage range, output current and voltage, current limit, etc. shall not vary more than 2% over the operating temperature range.
Output noise and ripple :	• less than 22 dB of random noise on C band at voice frequency over the entire operating range of the rectifier, including operation in the current limit mode, and at low, nominal and high input voltage conditions (with or without batteries and measured at the point of regulation) • less than 20 mV RMS in any 3 kHz band between 10 kHz and 20 MHz (measurements made with or without batteries at the output terminals of the rectifier and with the rectifier in the local sensing mode) • less than 250 mV peak to peak switching voltage spikes (measured differentially with an a 100 MHz oscilloscope)
Total harmonic distortion (THD) :	Less than 5%.
Efficiency :	Better than 89% at a nominal input voltage of 350 V ac and for an output current (load) greater than 80 A.
Power factor :	Better than 99% with an output current (load) greater than 80 A.
Heat dissipation :	The maximum heat dissipation is 1420 watts (4846 BTU / hr) for an output current (load) of 200 A at –58 V dc (when the ac input is 330-475 V)
Electromagnetic interference (EMI) :	The NT5C05CA / CB rectifiers when used in the rectifier cabinet NT6C43CA / CB (equipped with the ac EMI filter kit NT6C18KB, or the NT5C05CC without external EMI filter) meet the CISPR requirements for conducted and radiated EMI as specified in Publication 22 for Class "A" equipment.
Reliability:	The rectifier has an MTBF greater than 120 000 hours under normal operating conditions, at 77°F (25°C) as per Telcordia Technologies TR332 method.

Table 4 - Ambient conditions for the rectifier

Operating conditions	A minimum airflow clearance of 2 inches (5 cm) is required at the rear of the rectifier. The rectifier will operate properly under the following conditions. Temperature: 32°F to 122°F (0°C to +50°C) 32°F to 104°F (0°C to +40°C) with air filters Humidity: 0 to 95% RH (non-condensing) at 4 kPa max. equiv. to 7,000 ft. (2,100 m) above sea level
Transportation conditions	During transportation, the rectifier can be subjected to the following conditions without sustaining damage. Temperature: –67°F (–55°C) for 16 hours 140°F (+60°C) dry heat Humidity: 0 to 95% RH (non-condensing) at 4 kPa max. Vibration: 38 mm / s max. (10 Hz to 30 Hz) sinusoidal, 18-inch (457 mm) drop when packaged Pressure: 12 kPa min. equiv. to 49,212 ft. (15,000 m above sea level) Temperature shock : –58°F to 140°F (–50°C to 60°C)
Storage conditions	During storage, the rectifier may be subjected to the following conditions without damage : Temperature: –67°F (–55°C) for 16 hours to 140°F (+60°C) dry heat Humidity: 0 to 95% RH (non-condensing) at 4 kPa maximum The rectifier contains aluminum electrolytic capacitors that have a shelf life of five years or greater at the maximum rated storage temperature.

2.3. Mechanical and electrical specifications of a 1200 A cabinet

Table 5 - Mechanical specifications of the NT6C43CB 1200 A cabinet

Height :	84.00 inches (213.36 cm)
Depth :	23.63 inches (60.0 cm)
Width :	23.63 inches (60.0 cm)

Table 6 - Electrical specifications of the NT6C43CB 1200 A cabinet

Input voltage :	380 / 415 V ac three phase
Output voltage :	–46 V dc to –58 V dc
Output current :	1200 A

2.4. Ambient conditions of a 1200 A cabinet

Table 7 — Ambient conditions for the NT6C43CB 1200 A cabinet

Operating conditions	The cabinet is designed for use under the following ambient conditions. Temperature: 0°C to 50°C (32°F to 122°F) 0° to 40°C (32° to 104°F) with air filters Humidity: 0 to 95% RH (non-condensing) Altitude: sea level to 7,000 ft (2,100 m)
Storage conditions	During transportation and storage, the acceptable ambient conditions are : Temperature: –55°C (–67°F) +60°C (140°F) dry heat Humidity: 0 to 95% RH (non-condensing)

3. Installation

3.1. Mounting configurations

The NT5C05CA / CB / CC rectifiers are designed for installation in a 1200 A cabinet (NT6C43CB) or in a standard frame (NT6C40 or equivalent). In this chapter, a different procedure is provided for each mounting method. The rectifiers are shipped loose, not mounted in the frame or cabinet. Upon reception, remove the rectifier from its shipping carton and inspect it for physical damage. Report any damage to your immediate supervisor.

3.2. Tools and test equipment

The following tools and test equipment are required :

- screwdriver, flat blade, 3/16 inch (5 mm)
- potentiometer screwdriver, Bourns No. 60, or equivalent
- heavy cable strippers or electrician's knife
- heavy cable cutters (AWG 4/0 or metric No. 110)
- nut drivers (set)
- socket set (1/2 inch or 15 mm drive)
- torque limiting wrench (1/2 inch. or 15 mm drive)
- crimper, T&B, 15CA54R Violet die
- digital multimeter, Fluke 8000A or equivalent

3.3. Cautions and Warnings

The following precautions must be adhered to at all times when handling and installing power equipment.

CAUTION
Protecting the premises
Protect the floors and walls against damage with sheets of plywood, cardboard, or other suitable material when handling the equipment.

CAUTION

Preventing damage caused by over-tightening

Do not over-tighten nuts and bolts. Over-tightening can strip the threads or break the bolts. Apply the appropriate torque values.

CAUTION

Personal safety and protecting the equipment

Use a dolly truck, forklift, or hoist whenever possible when handling and moving the equipment, as power equipment is heavy. If a forklift is used, do not remove the packing material before having moved the equipment to its final location. If a dolly truck is used, the packing material can be removed in the reception area. When handling cabinets with equipment installed in them, exercise care to ensure they do not tip over, as they can be top heavy.

CAUTION

Preventing personal injury

When cutting material, wear gloves and goggles. Break all corners and sharp edges with a flat file.

CAUTION

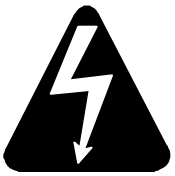
Optimizing the life of the equipment

Make sure there are no obstructions in front of the ventilation openings that can restrict the flow of air.

WARNING

Generator requirements for Emerson Energy Systems Power Systems

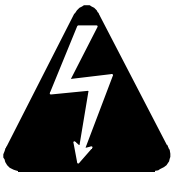
For information on selecting ac generators that will effectively maintain peak performance and operating characteristics, for all Astec APS power systems, go to the partners' section of the Emerson Energy Systems web site at www.EmersonEnergy-NA.com. To obtain access to the partners' section follow the instructions found on the partner' page, or dial our nearest local 1–800 technical support line (refer to "Appendix C : Technical service assistance" of this manual for the telephone number).



DANGER

Grounding

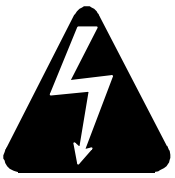
The frame ground leads must be connected before any other leads. This is to prevent the cabinets and any other metal structures from carrying dangerous ac or dc voltage levels.



DANGER

Protecting against electrical shocks

The cabling of the power plant, and all other required cabling, must be carried out by qualified personnel and in conformance with local and national electrical codes. AC input voltages to the rectifiers are at a dangerous level. Ensure that the circuit breakers are locked in the OFF position in the ac service panel before working on the power plant. Dangerous voltages may be present at the output dc terminals even if the rectifiers are OFF. Use a voltmeter to verify for the presence of such voltages. Do not put the circuit breakers to ON until the entire system has been assembled and you have been instructed to do so. Verify, and identify with a tag, the proper polarity of the battery leads before connecting them to the power plant.



DANGER

Short circuit hazard

The rectifiers, and the batteries in particular, can deliver high current if a short to ground occurs. When working on live equipment, remove all personal jewellery, use properly insulated tools, and cover any live busbars with a insulating sheet of canvas to prevent short circuits that could be caused by falling tools or parts.

3.3.1. Installing in a frame

When shipped, the NT5C05CA / CB / CC switch mode rectifiers are configured for installation in a standard frame. As the rectifier is heavy, use a manual forklift to mount the rectifier in a frame. If a forklift is not available, two persons, exercising care, can lift the rectifier into place and secure it.

Procedure 1 - Installing the rectifier in a frame

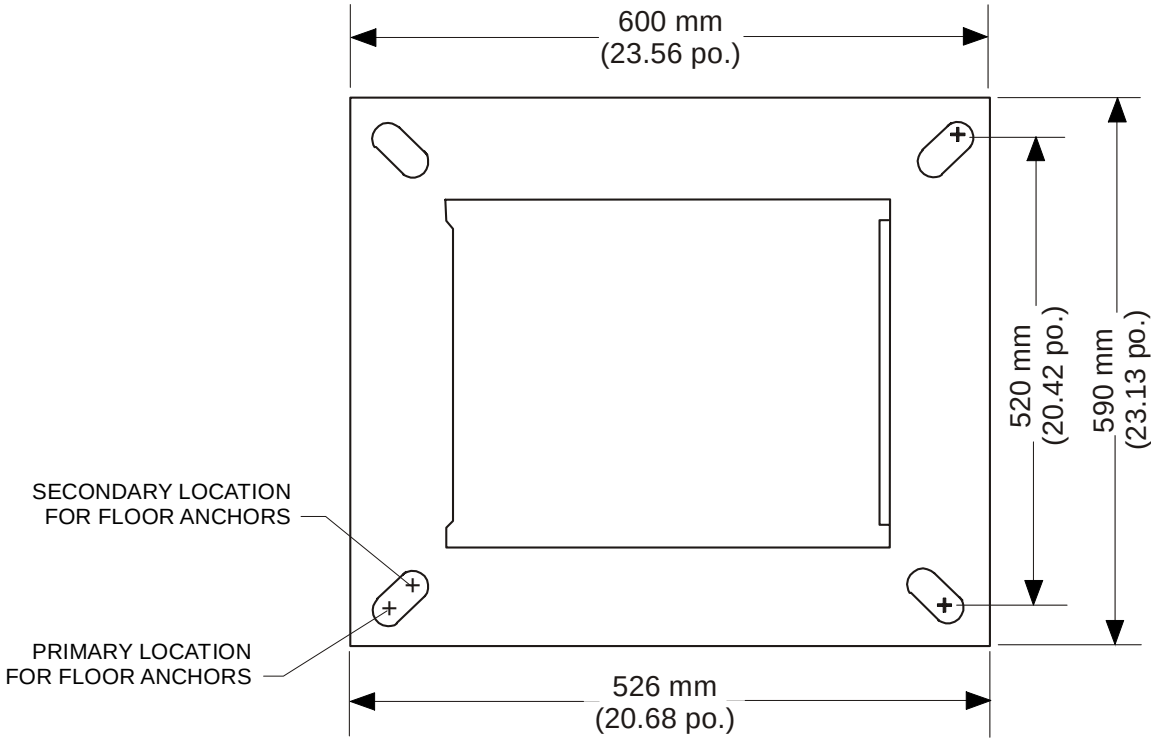
Step	Action
1	***Note :*** Install each rectifier beginning with the lowest mounting position in the frame. Align the mounting brackets of the rectifier with the mounting holes in the frame and insert the locating pins into these holes.
2	Lift the rectifier and align the middle holes in the mounting brackets of the rectifier with the locating pins inserted in the frame. Slide the rectifier into position onto the locating pins.
3	Secure the rectifier to the frame by inserting and tightening a mounting screw (provided) in the uppermost holes of each mounting bracket (one on the left side and one on the right side).
4	Remove the locating pins and install the other six mounting screws. Tighten the screws applying a torque of 6.5 ± 0.5 ft-lbs (8.5 ± 0.5 N-m).
—end—	

3.3.2. Installing in a cabinet

The cabinet is 23.56 inches (600 mm) wide and deep, and 84 inches (2134 mm) high. The anchors provided to secure the cabinet in place are intended for installation on 3000 psi (2 kg per sq. mm) compressive strength concrete. Anchors for seismic applications are available upon request. Slotted holes are provided in the base of the cabinet for anchoring. The primary locations should be used as a first choice (see Figure 3). If a steel-reinforcing rod is encountered when drilling the holes for the anchors

in the concrete floor, the secondary anchor locations may be used. An optional cabinet isolation kit is available consisting of four anchor bushings and a base pad. If this kit is installed, place the pad on the floor and the bushings on the anchors, and position the cabinet on top.

Figure 3 - Anchoring the cabinet



Procedure 2 - Installing a rectifier in a cabinet

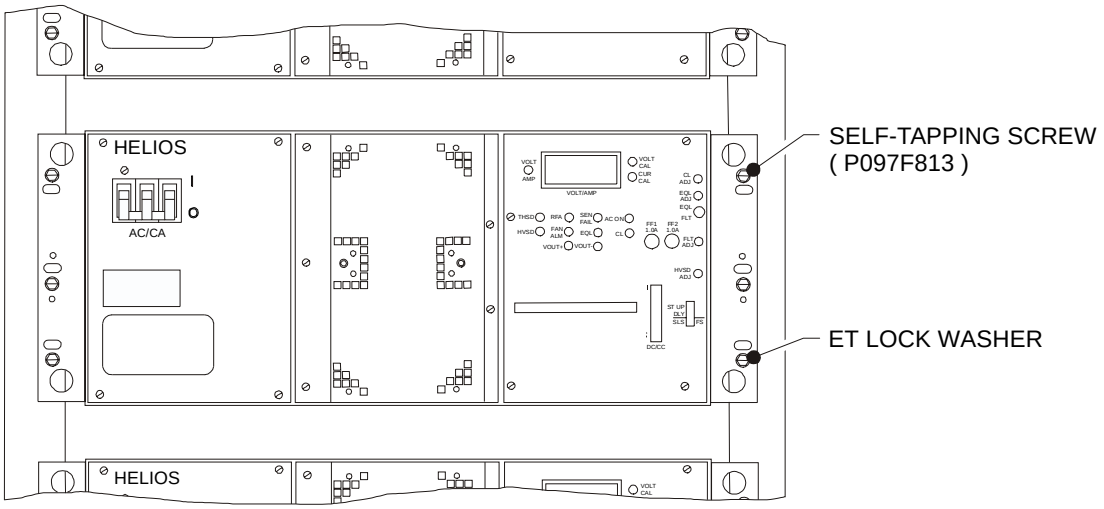
Step	Action
1	Loosen and remove the screws securing the mounting brackets to each side of the rectifier.
2	Reposition and secure the mounting brackets to the holes located nearest the front of the rectifier, on each side of the rectifier.
3	Remove the blank panel from the cabinet and put the self tapping screws in a secure location, for future use.

—continued—

Procedure 2 - Installing a rectifier in a cabinet (continued)

Step	Action
4	Place the rectifier on the L-shaped guides located in the lowest position of the cabinet and slide it towards the rear until the mounting brackets come into contact with the frame of the cabinet. The front of the rectifier should be flush with the front of the cabinet and the output bussing should be in contact with the riser busbars located at the rear of the cabinet.
5	Align the mounting holes in the brackets of the rectifier with the mounting holes in the frame. Secure the rectifier in place by inserting and tightening the self-tapping screws removed in Step 3. ***Note :*** Install an external tooth lock washer on one of the screws to assure good ground continuity between the rectifier and the frame.
—end—	

Figure 4 - Installing the rectifier



3.4. Cabling and connecting

The ac cables of the rectifier must always exit each rectifier from the right side, when viewed from the rear.

The dc cables of the rectifier must always exit each rectifier from the left side, when viewed from the rear.

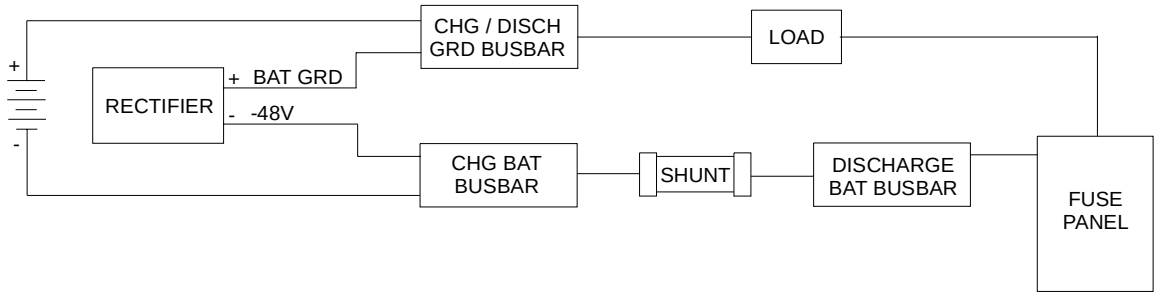
The system alarm interface cable must always exit each rectifier from the right side, when viewed from the front.

3.5. Connecting the dc output terminals to the busbars

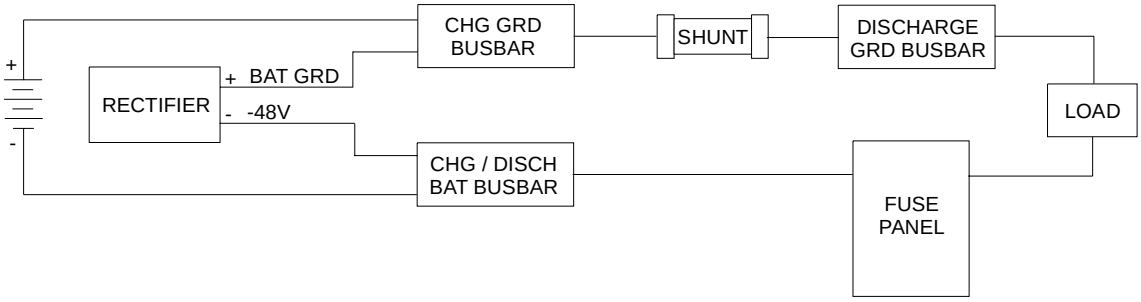
The dc outputs of the rectifier are connected to the busbars as illustrated in Figure 5. There are two methods :

- BAT GRD (+) of the rectifier connected to the CHG/ DISCH GRD busbar and the –48 V of the rectifier connected to the CHG BAT busbar
- BAT GRD (+) of the rectifier connected to the CHG GRD busbar and the -48V of the rectifier connected to the CHG/ DISCH BAT busbar

Figure 5 - Connecting the dc to the busbars with a shunt on the battery side or a shunt on the ground side



SHUNT ON THE BATTERY SIDE



SHUNT ON THE GRD SIDE (PREFERRED CONFIGURATION)

3.5.1. Securing the dc output terminals to the busbars in a 1200 A cabinet

For cabinet applications, no dc cabling is required; the output terminals of the rectifier are connected directly to the busbars.

Procedure 3 - Securing the dc output terminals to the busbars of the cabinet

Step	Action
1	Connect the BAT GRD output terminal of the rectifier to the BR busbar, and the –48 V output terminal of the rectifier to the –48 V busbar located at the rear of the cabinet.
2	Tighten the bolts by applying a torque of 6.5 ± 0.5 ft-lbs (8.5 ± 0.5 N-m).
—end—	

3.5.2. Running and connecting the dc between busbars and a rectifier

For frame applications, use terminal lug A0361762, supplied with the unit, and no. 110 (4/0) metric cable.

Procedure 4 - Typical dc cabling in a frame application

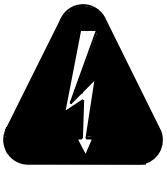
Step	Action
1	Connect the BAT GRD output terminal of the rectifier to the CHG GRD busbar of the power plant. Connect the –48 V output terminal of the rectifier to the CHG / DISCH BAT busbar of the power plant (see Figure 5).
2	Apply a torque of 6.5 ± 0.5 ft-lbs (8.5 ± 0.5 N-m) on the bolts securing the lugs to the rectifier terminals.
—end—	

3.6. Connecting ac to the rectifiers

WARNING

Electrical connections should meet standards

The electrical installation must be carried out by qualified personnel and in accordance with local electrical codes.



DANGER

Hazardous potentials

Input voltage to the cabinet is at a hazardous potential. Make sure the power is OFF and that the lever in the ac service panel is locked in the OFF position before attempting to connect the input line voltage to the ac box of the cabinet.

Procedure 5 - Cabling the ac input to the NT5C05CA / CB rectifiers

Step	Action
1	Install the ac breaker (30 A / 3 phase per rectifier) in the 380 / 415 volts ac service panel and lock it in the open (OFF) position.
2	Put the ac breaker to OFF.
3	Run the ac armored cable (metric no. 25 [10 AWG] 3 conductors and ground) from the service panel, through the top of the cabinet, to the rear of the rectifier.
4	Secure the ac cable to the side of the cabinet using cable ties and adhesive anchors. Make sure the cable are located in a manner that will not interfere with the insertion of the rectifier (see Figure 6).
5	Ground the conduit sheath to the ac service panel. Insulate the conduit connector at the rectifier end with electrical tape to isolate it from the ac ground.
6	Remove the two ac protection plates located at the rear of the rectifier.
7	Strip 10 inches (250 mm) of armored insulation from the end of the ac cable. Insert the wires in the 90° conduit connector (see Figure 7).
8	Run the signal cable from the rectifier to the interconnect board or controller as described in the "Control signal connections" section.
9	Connect the green ground wire to the FR GND terminal.
10	Connect the power leads to the L1, L2 and L3 terminals (any phase sequence) (see Figure 7).
11	Tighten the elbow connector and reassemble the ac protection plate.
12	Run the signal cable from the rectifiers to the interconnect board or controller as specified in the " Connecting the control signals" section.
13	Secure the signal cables to the insulating busbar support, located in the cabinet, with cable ties.
14	Start-up the rectifier as described in the “ Start-up “ procedure.
—end—	

Figure 6 - Cabling ac the NT5C05CA / CB rectifiers

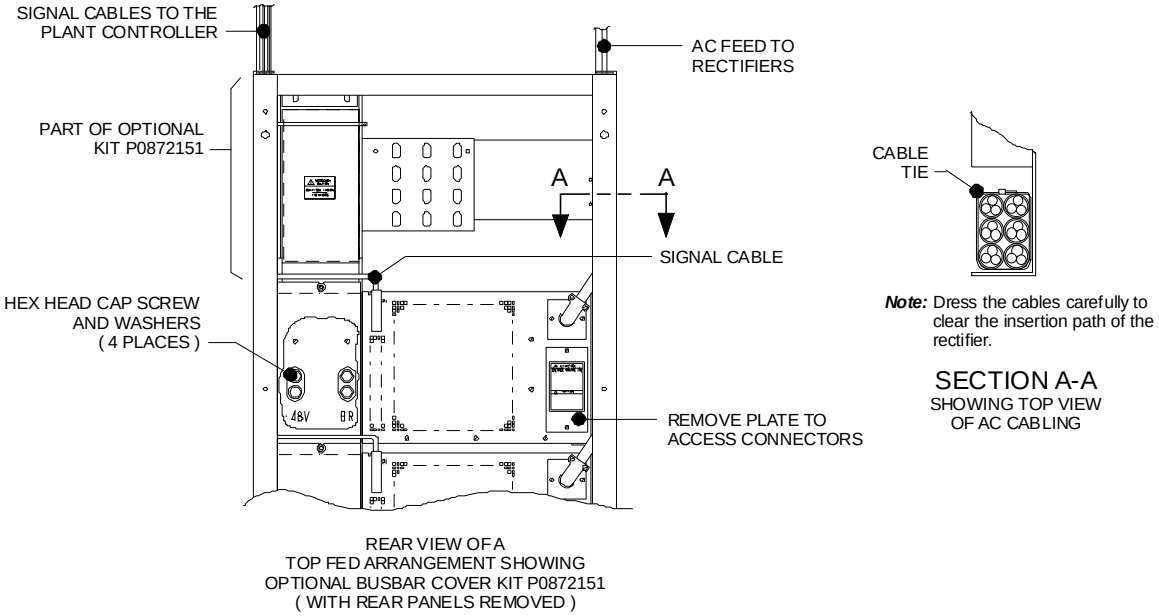
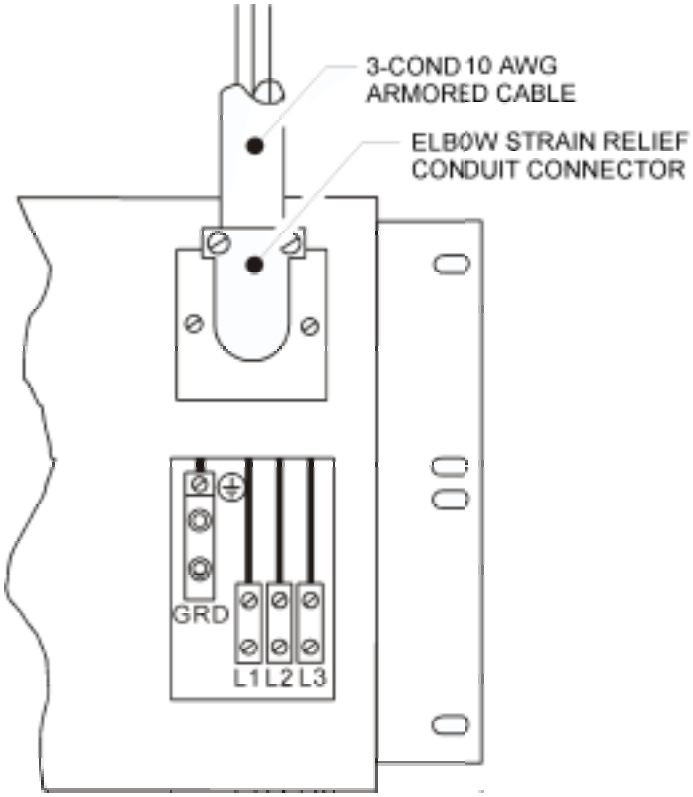


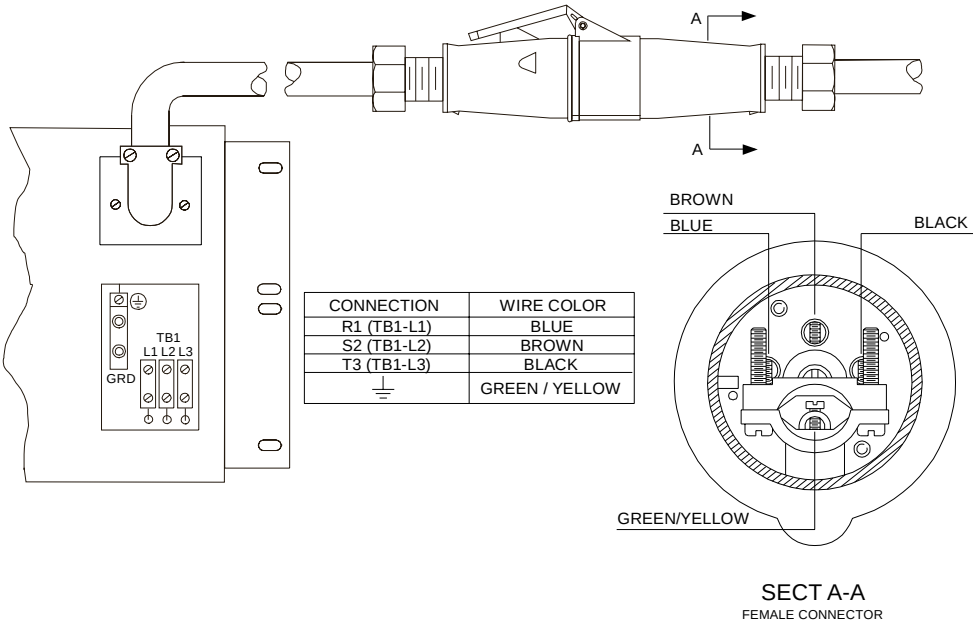
Figure 7 - Connect the power leads to the L1, L2 and L3 terminals of the rectifier



Procedure 6 - Connecting the ac male plug between the NT5C05CC rectifier and the ac female plug in a 1200 A cabinet

Step	Action
1	Install the ac breaker (30 A / 3 phases per rectifier) in the 380 / 415 volts ac service panel.
2	Put the ac breaker for the NT5C05CC rectifier, located in the ac service panel, to OFF.
3	Run the metric no. 25 (10 AWG) ac supply cable (3 conductors and ground) to the female receptacle (see Figure 8). Connect the female connector to the male connector.
4	Run the signal cable from the rectifier to the interconnect board or controller as specified in the " Connecting the control signals " section.
5	Secure the signal cables to the insulating busbar support, located in the cabinet, with cable ties.
6	Start-up the rectifier as described in the “ Start-up “ section.
—end—	

Figure 8 - Connecting ac to the rectifier NT5C05CC



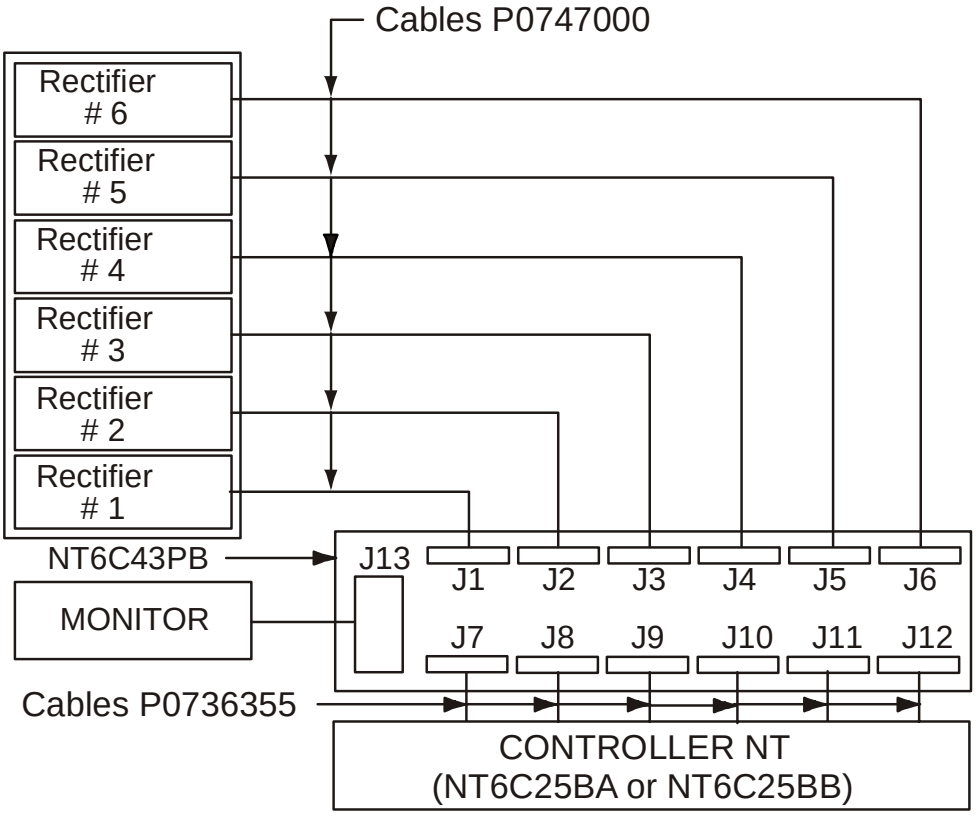
3.7. Connecting the control signals

For all applications with conventional controllers (such as NT6C25BA or NT6C25BB) or front access controllers (NT6C25FA), execute the steps contained in Procedure 7 to connect the NT5C05CC rectifier (see Figure 9).

Procedure 7 - Connecting the NT5C05CC to the controller

Step	Action
1	Connect each rectifier to the NT6C43PB board (positions J1 to J6), located at the top front of the cabinet or frame, with P0747000 cables.
2	• Connect the NT6C43PB board (positions J7 to J12) to the controller with P0736355 cables for conventional controllers ; and with P0736268 cables for front access controllers.
—end—	

Figure 9 - Typical connections between rectifiers and the conventional controller



Procedure 8 - Connecting an NT5C05CC rectifier directly to a controller

Step	Action
1	If an NT6C43PB interconnect board is not available, each rectifier must be connected directly to the controller with the following cables : • P0723784, P0723785 or P0723786 (for conventional controllers) • P0723708, P0723709 or P0723210 (for front access controllers)
—end—	

For controllers not manufactured by Emerson Energy Systems see Table 12 in the " Functional Description " chapter describing the pin assignments of the rectifier. Refer to Table 8 for the pin assignments of connectors J7 to J12 on board NT6C43PB.

Note: The alarm and control signals in Table 8 are all ground signals except for the RC– signal that is a –48 V battery signal.

Table 8 - Pin assignment for connectors J7 to J12

Pin	Label	Function	Input/ Output
1	EQL	Equalize	Input
2	RG+	Remote sense	Input
3	RC–	Remote sense	Input
4	FAN ALM	Fan fail alarm	Output
5	HVSDR	High voltage shutdown reset	Input
6	HVSD	High voltage shutdown	Input
7	RFA	Rectifier failure alarm	Output
8	TR	Temporary release	Input

3.7.1. Monitoring of the shunt current

A 12-pin connector (J13) is also available on the NT6C43PB interconnect board for monitoring the individual output current shunt readings (250 A / 50 mV for example) of each rectifier in a cabinet or a frame (see Table 9).

Table 9 - Pin assignment for connector J13

Pin	Function
J13-1	SH+ (rectifier 1)
J13-2	SH– (rectifier 1)
J13-3	SH+ (rectifier 2)
J13-4	SH– (rectifier 2)
J13-5	SH+ (rectifier 3)
J13-6	SH– (rectifier 3)
J13-7	SH+ (rectifier 4)
J13-8	SH– (rectifier 4)
J13-9	SH+ (rectifier 5)
J13-10	SH– (rectifier 5)
J13-11	SH+ (rectifier 6)
J13-12	SH– (rectifier 6)

4. Functional description

4.1. Overview

4.1.1. Input circuit

The input circuit offers the following characteristics :

- ac rectifying
- EMI filtering
- inrush current limiting, a walk-in circuit limits the output current rise to 25 A per second
- low and high ac inhibit
- power factor compensation
- surge voltage protection
- ac breaker for input protection

For all input and output conditions specified in this manual, when the rectifier is turned on, the ac current will not exceed the maximum steady-state value.

4.1.2. Output circuit

The output circuit offers the following characteristics :

- shunt for output dc current sensing
- 225 A dc circuit breaker for output protection

4.1.3. Monitoring and control circuits

The monitoring and control circuits offer the following characteristics :

- soft start
- rectifier fail alarm (RFA)
- control for local and remote equalize (EQL)
- temporary release (TR)
- thermal shutdown (THSD)
- input ac monitoring
- local and remote high voltage dc shutdown (HVSD)
- local and remote HVSD reset
- fan failure detection

4.1.4. Output capacitors

The output capacitors will be completely discharged (< 2 V) two minutes after the ac power has been removed and the rectifier has been disconnected from the batteries or the parallel rectifiers.

4.2. Description of the front panel

4.2.1. Breakers

DC circuit breaker

A dc circuit breaker is provided to protect against current overload and to manually disconnect from the power plant.

When the breaker is in the 0 (OFF) position, an RFA is triggered and the remote sense leads RG+ and RC– are internally disconnected. The rectifier will continue to operate, allowing the adjustment of the FLT, EQL and HVSD set points.

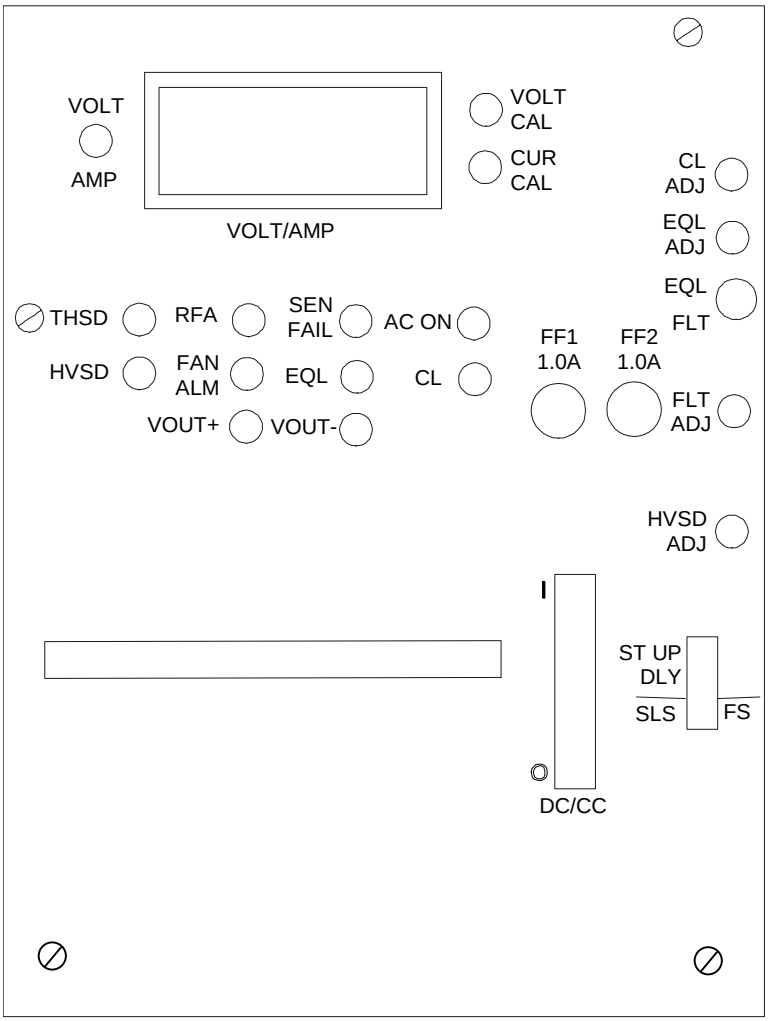
AC breaker

The input ac circuit breaker can be used to locally turn the rectifier ON or OFF. The local ON / OFF control overrides any remote control signals (for example, TR). Putting the breaker to OFF causes an RFA to be issued and the RFA LED to light up, as long as the rectifier output is connected to batteries.

4.2.2. Switches, controls and LEDs

There are switches and potentiometers on the front panel to adjust the operating parameters of the rectifier. The LED indicators indicate the operating and alarm conditions.

Figure 10 - Front panel controls and LEDs



4.2.3. Front panel LEDs

Table 10 - Designation of the LEDs on the front panel

LED	Color	Description
AC ON	Green	Input ac voltage operational
CL	Yellow	Current Limit
EQL	Yellow	Rectifier is in equalize mode
FAN ALM	Red	Fan fail alarm
HVSD	Red	High voltage shutdown
RFA	Red	Rectifier fail alarm
SEN FAIL	Red	Remote sense fail
THSD	Red	Thermal shutdown

AC ON (ac voltage monitoring)

The rectifier monitors the input voltage and if the voltage exceeds the set limit, it will inhibit its operation and trigger a rectifier failure alarm (RFA). The rectifier will resume its normal operation automatically when the specified input voltage has been re-established.

CL (current limit indicator)

This LED lights up if the rectifier is in current limit. The rectifier limits the output current to 205 A $\pm$ 5 A (adjusted in the factory), 50% to 105% of the rated output current.

EQL (equalize)

Indicates the rectifier is in equalizing mode.

FAN ALM (fan failure alarm)

This LED lights up when the FAN ALM is activated due to a defect in the fan system. The fan configuration includes redundancy to ensure the rectifier will continue working properly if one of the fans fails. If only one fan fails, a rectifier failure alarm RFA will not be triggered. It is, however, imperative to repair or change the fan unit as soon as possible to preserve this redundant feature.

HVSD (high voltage shutdown)

The rectifier monitors itself for high voltage and will shut down when its output voltage exceeds a preset adjustable value (between -52 V and -60 V).

RFA (rectifier failure alarm)

The rectifier monitors its operation and triggers a global RFA if it detects an internal failure, causing the RFA LED to light up. One of the following will trigger an alarm :

- abnormal or out of range ac input voltage
- output fuse failure
- system or internal shutdown (thermal, HVSD, TR)
- internal failure causing a power switching malfunction

If the switching malfunction is caused by an improper adjustment of the output float voltage, the RFA alarm will not be triggered. The RFA feature will be activated if the ac power is removed in a system where batteries are present.

SEN FAIL (sense fail alarm)

This LED lights up if the remote sense leads are not connected, or if the RC fuse has blown.

THSD (thermal shutdown)

This LED lights up when the rectifier is protecting itself against overheating by suspending its operation for the duration of the high temperature condition. An RFA alarm will also be triggered.

4.2.4. Local and remote adjustments and controls

The current and voltage calibration, adjustment and control can be set through potentiometers and switches (see Table 11) located on the front panel, or by remote signals sent from the controller (see Tables 8 and 12).

Table 11 - Adjusting the potentiometers and switches

Potentiometers	Description
CL ADJ	Current limit adjust (100 A to 210 A)
CUR CAL	Current reading calibration
EQL ADJ	Equalize voltage adjust (0 V to –4 V)
FLT ADJ	Float voltage adjust (–46 V to –58 V)
HVSD ADJ	High voltage shutdown adjust (–52 V to –60 V)
VOLT CAL	Voltage reading calibration
Switches	**Description**
EQL / FLT	Equalize / Float selection switch
SLS / FS	Slope load sharing / Forced load sharing selection
ST UP DELAY	Start-up delay selection DIP (4 sec to 2 min)
VOLT / AMP	Voltage and current display selection switch

Table 12 - Rectifier input / output signals to the controller

Designation	Description
RG+ / RC–	External reference voltage across the batteries measured through the controller to regulate the voltage.
HVSD	Remote High Voltage Shutdown input activated by a BAT RTN signal.
HVSDR	Remote High Voltage Shutdown Reset input activated by a BAT RTN signal.
TR	Remote Inhibit input activated by a BAT RTN signal.
EQL	Remote Equalize input activated by a BAT RTN signal.
RFA	Rectifier Failure Alarm output activating a form C contact
F ALM	Fan Failure Alarm output activating a form C contact
SHUNT (+) and SHUNT (–)	Rectifier Current input / output (50 mV / 250 A)
CURRENT SHARE	Common Forced Current Share Mode (0-12 V)

4.2.5. Voltage / current display—test and measurement

CUR CAL / VOLT CAL potentiometers

These potentiometers are used to calibrate the digital display meter for current and voltage measurements. As the two potentiometers affect each other, current calibration must be performed before voltage calibration.

VOLT / AMP digital meter switch

This switch is used to select the measurement display mode of the digital meter. The output voltage or the output current modes can be selected.

VOUT+, VOUT– test points

These test points are used to measure the voltage at the point of regulation. A 5 kohm resistor is placed in series with both sensing leads to prevent short-circuits at the jack terminals. The resistor may affect reading accuracy, depending on the impedance of the meter. Refer to the *Instruction Manual* for your meter to determine its internal impedance and correction factor.

4.2.6. Float and equalize voltage control

Local FLOAT / EQL switch and potentiometers

The rectifier is equipped with a FLOAT / EQL switch.

When the FLOAT / EQL switch is held in the EQL position, the rectifier goes into equalize mode and boosts the output voltage to the value set by the EQL potentiometer.

When the switch FLOAT / EQL is held in the FLT position, the rectifier delivers a float voltage set by the FLT potentiometer.

Remote equalize control EQL

The rectifier is equipped with remote equalize control. This control is activated by a remote ground signal (BAT RTN). The rectifier returns to normal (float voltage) operation when this signal is removed.

4.2.7. Current limit adjustment and rectifier regulating test

CL ADJ potentiometer

The rectifier limits the output current to a select value ranging from 100 A to 210 A, set by the CL ADJ potentiometer. The factory adjustment is 205 A ±5 A. Extended periods of operation in the current limiting mode and repeated transitions between constant-voltage operation and constant-current operation have no detrimental effect on the performance or service life of the rectifier.

The rectifier can be started when it is connected across a completely discharged battery without requiring human intervention or operating protective devices. A transition from constant voltage operation to constant current operation and from constant current operation to constant voltage operation occurs automatically, as determined by the output current. The current limiting circuit is functional in float and equalize modes.

4.2.8. Rectifier parallel operation

The rectifier can operate in parallel with other rectifiers having similar output characteristics. It shares the total load in proportion to its output rating. Two methods for sharing load current are available :

- Slope sharing
- Forced sharing

Selecting either mode is done by setting the two bottom DIP switches, SLS / FS, located on the front panel. The rectifier is factory set to the slope sharing mode.

Slope sharing (SLS)

When both bottom DIP switches are set to the SLS position, conventional load sharing is achieved through a -300 mV slope on the output voltage of the rectifier, from no load to full load. This mode should be used when rectifiers from different manufacturers are not all equipped with the forced load-sharing feature. In this mode, the units will share the load within ±10% of their maximum output rating.

To accurately preset the float voltage of the rectifier, its current in the plant environment must be predicted and the preset output floating voltage must be calculated using the formula found below. In the formula, 0.8 volts is added to the float voltage to compensate for an internal voltage drop when the rectifier dc breaker is put in the ON position.

$$V\,(\text{preset}) = Vo\,(\text{desired}) + 0.8\ V + \left(\frac{Io\,(\text{running})}{200} \times 300\ \text{mV}\right)$$

Example 1 : If the rectifier is expected to provide 100 A at 48 V

$$V\ (\text{preset}) = 48\ V + 0.8\ V + \left(\frac{100}{200} \times 300\ mV\right)$$

$$V\ (\text{preset}) = 48\ V + 0.8\ V + 0.15\ V = 48.95\ V$$

Example 2 : If the rectifier is expected to provide 40 A at 48 V

$$V\ (\text{preset}) = 48\ V + 0.8\ V + \left(\frac{40}{200} \times 300\ mV\right)$$

$$V\ (\text{preset}) = 48\ V + 0.8\ V + 0.06\ V = 48.86\ V$$

Forced sharing (FS)

When both bottom DIP switches (SLS / FS) are set to the FS position, forced load sharing is achieved by an internal control circuit that modifies the loop reference to equally share the output currents between rectifiers. The setting of the output voltage is not modified with changes in output load, as is the case in the slope share mode. In this mode, the rectifiers will share the load within ±2 % of their maximum output rating.

For this to occur the rectifiers must communicate their operating current to the other rectifiers in the same power plant. The current share terminal of all the rectifiers (P1-17) in the same power plant must be connected through the control cables and controller. In applications using the NT6C43PB interconnect board, such a connection is implemented automatically.

Adjust the rectifier float voltage to the desired system float voltage, plus 0.8 volts, to compensate for an internal drop when the rectifier dc breaker is put in the ON position.

Example 3 : for 48 V float voltage

$$V\ (\text{preset}) = 48\ V + 0.8\ V = 48.8\ V$$

4.2.9. HVSD (high voltage shutdown)

HVSD ADJ (high voltage shutdown adjust) potentiometer

Use this potentiometer to set the internal threshold level at which the local high voltage shutdown condition should occur.

Remote HVSD

In addition to the local high voltage shutdown feature, the controller of the power plant controller can shut down any rectifier by sending a high voltage shutdown signal, ground (BAT RTN) pulse. The rectifier will shut down within 50 ms if it is supplying more than 10% of its full load rating.

As is the case for the internal high voltage shutdown condition, two HVSD events must occur within an interval of two minutes to lock out the rectifier permanently. An ac breaker reset or an HVSDR signal can be used to restart the rectifier.

Local and remote HVSD reset

The rectifier may be reset from an HVSD condition locally by :

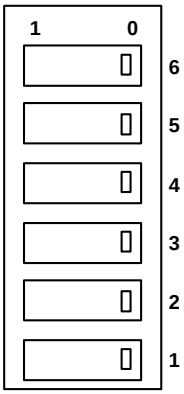
- toggling the ac circuit breaker to OFF then to ON (or the ac breaker in the distribution panel)
- sending a remote ground signal to the HVSDR input through the controller restart (provided the 'TR' lead has not been activated)

4.2.10. TR (temporary inhibition) and sequential start

Sequential start

The TR input can be interfaced to an external sequential start circuit.

Table 13 - Setting the start-up delay



NOTE: Switches 3 to 6 (top four switches) are used to set the start-up delay.

SWITCH #	POSITION 1	POSITION 0	DELAY	POSITION 1	POSITION 0	DELAY
6		X	4 SEC	X		68 SEC
5		X			X	
4		X			X	
3		X			X	
6		X	12 SEC	X		76 SEC
5		X			X	
4		X			X	
3	X			X		
6		X	20 SEC	X		84 SEC
5		X			X	
4	X			X		
3		X			X	
6		X	28 SEC	X		92 SEC
5		X			X	
4	X			X		
3	X			X		
6		X	36 SEC	X		100 SEC
5	X			X		
4		X			X	
3		X			X	
6		X	44 SEC	X		108 SEC
5	X			X		
4		X			X	
3	X			X		
6		X	52 SEC	X		116 SEC
5	X			X		
4	X			X		
3		X			X	
6		X	60 SEC	X		124 SEC
5	X			X		
4	X			X		
3	X			X		

Remote ON / OFF control TR

When a ground signal is applied to the 'Temporary Release' (TR) input, the rectifier inhibits its operation and triggers the RFA. When the remote ground signal is discontinued the rectifier returns to normal operation (see Table 14).

Start up delay DIP switch

The rectifier can provide a start-up delay of from 4 seconds up to 120 seconds, with a resolution of 8 seconds and an accuracy of $\pm$1 second. Use of this feature is recommended when two or more rectifiers are connected to a common ac input to stagger the inrush currents. A front panel DIP switch can be set to provide the start-up delays listed in Table 13.

4.2.11. Control signals on connector P1

The P1 connector, located at the rear of the rectifier, can be used to verify all the control and alarm signals when troubleshooting the rectifier (see Table 14).

The control inputs are activated by a ground (BAT RTN) signal. The alarms, extended by relay contacts, are isolated from each other and the rectifier frame. All contacts are rated 60 V and 0.5 A dc. The normal status of each contact is defined when the rectifier operates normally in the remote sense mode with no alarm. Contacts NC (normally closed) and NO (normally opened) refer to the de-energized state of their relay coils.

Table 14 - Control signal connections on P1

Connection	Signal	Description
P1-1	EQL	Equalize
P1-2	RC –	Remote sense (–)
P1-3	HVSDR	High voltage shutdown reset
P1-4	RFA (NC)	Rectifier fail alarm (NC)
P1-5	FAN ALM (NC)	Fan fail alarm (NC contact)
P1-6	FAN ALM (C)	Fan fail alarm (C)
P1-7	SH–	Output current shunt voltage (-)
P1-8	RFA (NO)	Rectifier fail alarm (NO)
P1-9	SENSE (C)	Sense fail alarm (C)
P1-10	SENSE (NO)	Sense fail alarm (NO)
—continued—		

Table 14 - Control signal connections on P1 (continued)

Connection	Signal	Description
P1-11	NC	No connection
P1-12	NC	No connection
P1-13	CB OFF (NC)	Output breaker OFF (NC)
P1-14	RG+	Remote sense (+)
P1-15	TR	Rectifier temporary released by controller
P1-16	HVSD	High voltage shutdown
P1-17	CURRENT SHARE	Forced share link
P1-18	RFA (C)	Rectifier fail alarm (C)
P1-19	SH+	Shunt (+)
P1-20	FAN (NO)	Fan fail (NO)
P1-21	GRD	Reference ground
P1-22	SENSE FAIL (NC)	Sense fail alarm (NC)
P1-23	NC	No connection
P1-24	NC	No connection
P1-25	CB OPEN (C)	Output breaker OFF (C)

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5. Operation

5.1. Standard settings

The parameters of the NT5C05CA / CB / CC rectifiers are set as indicated in Table 15. For different settings refer to User Manual Voltage_level entitled *Voltage Level Limits for Power Plants, Rectifiers and Controllers.*

Table 15 - Standard settings for the rectifier

Parameter	Setting
Rectifier float output voltage (FLOAT)	52.1 ±0.1 V dc
Rectifier equalize output voltage (EQUALIZE)	52.8 ±0.1 V dc
Rectifier high voltage shutdown threshold	56.5 ±0.1 V dc
Rectifier output current limit	205 A ±5 A
Rectifier start delay	4 sec
Low ac input disconnect	330 ±5 V ac
Low ac input reconnect	350 ±5 V ac
High ac input disconnect	475 ±5 V ac
High ac input reconnect	460 ±5 V ac
Load sharing method	Slope

5.2. Starting up and adjusting

Procedure 9 - Starting up the rectifier

Step	Action
1	Put the dc circuit breaker to OFF (0 position). Open the sensing leads by removing the corresponding RC fuse (when the rectifier is used with a controller) or by disconnecting the alarm and control cable (when the rectifier is used without a controller).
2	Put the ac circuit breaker in the main ac service panel to ON.
3	Put the 25 A, 3Ø, ac circuit breaker of the rectifier being tested to ON. The green ac ON LED should light up. ***Note :*** The output capacitors are precharged automatically when the dc cables are connected at the rear of the rectifier.
4	Put the meter selector to the VOLT position. The meter will display the voltage value to which the rectifier has been adjusted.
5	Connect a digital multimeter to test points VOUT+ and VOUT– on the front panel. The voltage reading should be within 1% of the rectifier meter reading. If not, calibrate it as described in the " Maintenance " section.
6	Determine the system requirements for float, equalize and HVSD limits by referring the User Manual Voltage_Level entitled *Voltage Level Limits for Power Plants, Rectifiers and Controllers*.
7	If the factory threshold limits of the rectifier must be verified or changed, go to Step 8; otherwise go to Step 14.
Adjusting the high voltage shutdown (HVSD)	
8	Put the dc circuit breaker to OFF (O).
9	Turn the HVSD potentiometer fully clockwise.
10	Turn the FLT potentiometer slowly clockwise to set the output voltage on the display of the rectifier to the required HVSD threshold. The EQL / FLT switch and the EQL potentiometer are used if the voltage cannot be set with the FLT potentiometer.
11	Turn the HVSD potentiometer counterclockwise until the rectifier shuts down.
12	Turn the FLT potentiometer counterclockwise two turns and put the ac breaker to OFF.
13	Wait a few seconds for the rectifier to shut down and put the ac breaker to ON to reset it.
—continued—	

Procedure 9 - Starting up the rectifier (continued)

Step	Action
Adjusting the float voltage	
14	Ensure that the EQL / FLT switch is on the FLT position.
15	To adjust the float voltage to the proper level, turn the FLT potentiometer clockwise to increase the voltage or counterclockwise to decrease it.
Adjusting the equalize voltage (EQL)	
16	Set the EQL / FLT switch to EQL. Turn the EQL potentiometer clockwise to increase the voltage or counterclockwise to decrease it.
17	Put the FLOAT / EQL switch in the FLOAT position.
Adjusting the slope share	
18	Select the slope share mode by setting the two bottom DIP switches to SLS (see Figure 10). Verify that the rectifier displays the required float value. If required, adjust it with the FLT potentiometer.
19	Connect the sense leads by inserting the RC fuse in the controller or by reconnecting the control cable.
20	Put the dc breaker located on the front of the rectifier to ON.
21	The rectifier is now connected to the system and should carry some current. If it is connected in parallel with other rectifiers, verify that the total system current is shared equally amongst the rectifiers. Put the switch on each rectifier to AMP. Find the mean current of the rectifiers by adding all the currents measured on each rectifier and dividing the total current by the number of rectifiers $\frac{I_T}{n} = \frac{I_1 + 1_2 + I_3 \ldots + I_n}{n}$ Set the current from each rectifier to this mean value. If the current reading of one of the rectifiers is too low, or is 0, slowly increase the current by turning the FLT potentiometer clockwise until proper sharing is achieved. If the current reading is too high or if rectifier is in the current limit mode, turn the FLT potentiometer counterclockwise. ***Note :*** Adjust all the rectifiers in sequence to the mean value of the currents, and readjust more precisely if necessary.
Verifying the current limit	
22	Turn OFF some of the other rectifiers to force the rectifier under test to pick up a load current of at least 210 A. When the rectifier reaches about 205 A, the yellow CL LED should light up.
—continued—	

Procedure 9 - Starting up the rectifier (continued)

Step	Action
23	Turn ON the other rectifiers in the system.
Setting the start-up delay	
24	Use this feature to reduce the inrush currents when two or more rectifiers are connected to a common ac input. Set the DIP switches on the front panel for the required start-up delay, from 4 to 124 seconds (see Table 13).
Adjusting the forced load sharing	
25	If the forced share mode is chosen, adjust the float voltage of each rectifier to the appropriate value plus 0.8 volts in slope share mode, as described above. For example, to have a 52.1 V float voltage : 52.1 V +0.8 V = 52.9 V. This compensates for the internal voltage drop when the dc breaker of the rectifier is put in the ON position. Connect all the FS wires of the rectifiers together and set the two bottom DIP switches, located on the front panel, to FS for forced load sharing (see Figure 10).
26	If the rectifiers are connected to the NT6C43PB board, in the cabinet or frame option, the P1-17 signals from all the rectifiers are automatically connected. After step 25 has been completed, the rectifiers will automatically share the output current. When forced load sharing is desired, but the NT6C43PB board is not used or is bypassed, pins P1-17 of all the rectifiers must be made common at a single point. This connection could be a splice connection of all the P1-17 wires in the control cables, using a 2B16 splice from T&B (or equivalent) in the control panel. The E1 terminal on the NT6C43PB board can be used when forced load sharing is desired amongst rectifiers on two, or more, cabinets or frames. In this case, the E1 terminal from all the cabinets or racks must be daisy chained with metric No. 7 (AWG 22) wire.
27	Repeat step 21, but in equalize mode, to verify that the current is shared equally amongst the rectifiers when a remote equalize signal is applied, or when all local FLOAT / EQL toggle switches are toggled in the EQL position. If the current reading is too low, or is 0, turn the EQL potentiometer clockwise until proper sharing is achieved. If the current is too high, or if the rectifier is in the current limit mode, turn the EQL potentiometer counterclockwise.
28	Deactivate the EQL mode to return to the normal float mode.
—end—	

6. Maintenance

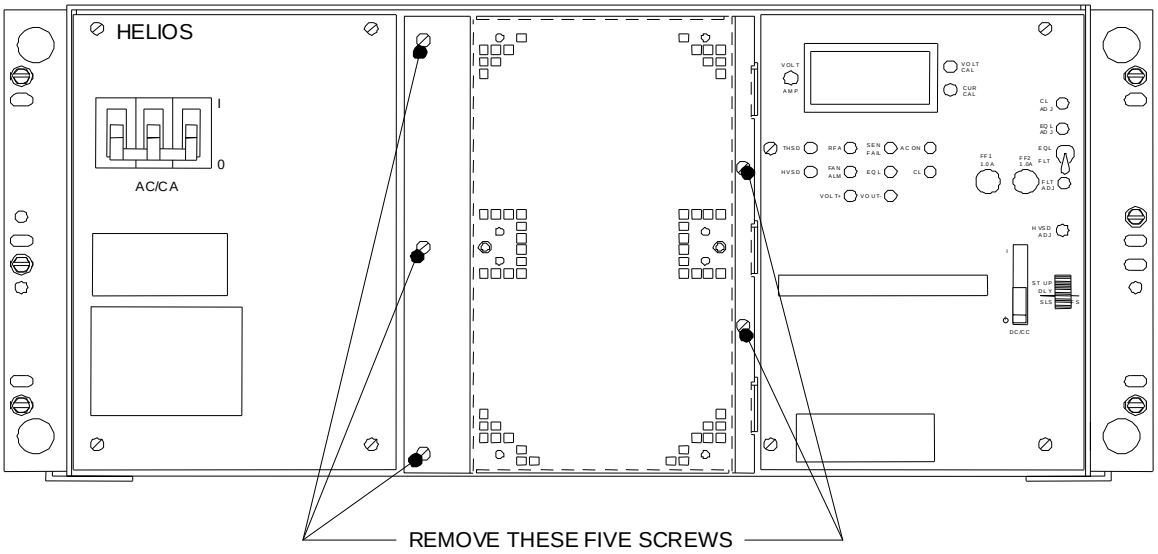
6.1. Replacing the air filter

In dusty environments, the use of air filters is strongly recommended. If used they should be replaced at least once a year.

6.2. Replacing the fan unit

The fan unit, consisting of four fans and a fan plate, can be replaced. To install a new fan unit, execute the steps outlined in Procedure 10 and illustrated in Figure 11.

Figure 11 - Replacing the fan unit



CAUTION

Preventing short circuits

The replacement operation is safe, as only SELV circuitry is present behind the fan assembly. However, due to the possible presence of residual charges in the output circuit, do not use metal tools within the rectifier enclosure. To remove the fan assembly mounting screws you need a screwdriver, but all the other operations described below can and should be performed without any tools.

Procedure 10 - Replacing the fan unit

Step	Action
Disassembling	
1	Put the ac and dc breakers to OFF.
2	Remove the five screws securing the fan plate (see Figure 11).
3	Swing open the assembly and disconnect all four fan cables.
4	Lift the assembly out the holes and pull it out towards you.
Re-assembling	
5	Insert the hinged bracket of the new assembly into the slotted holes on the left and reconnect the cables to the four fans.
6	Place the four fan cables close to the display panel, removing as much slack length as possible, so the cables will not interfere with the fan blades after the fan unit is secured in place.
7	Swing the fan unit closed and secure it in plate with the five screws.
8	Check fan fuses FF1 and FF2 and replace as required.
9	Put the ac and dc breakers to ON.
—end—	

6.3. Calibrating the Volt / Amp Multimeter

In a cabinet or frame application, where the signal cables are connected to the NT6C43PB board, use a digital multimeter, at J13 on the NT6C43PB board, to monitor the shunt reading of the rectifier, as indicated in Table 9. In any applications where the NT6C43PB board is absent or has been bypassed, pins P1-19 and P1-7 of the signal connector provide the shunt reading. To access pins P1-19 and P1-7 use a cut P0747000 cable. If the meter must be calibrated execute the steps in Procedure 11.

Procedure 11 - Calibrating the meter

Step	Action
1	Make sure the remote sense leads are disconnected by removing the corresponding RC– fuse from the controller.
2	Set the VOLT/AMP switch to AMP. Set the output load of the plant so the rectifier delivers a current of approximately 100 A. Measure the voltage between VOUT+ and VOUT –, located on the front panel, with a digital meter.
3	Convert this measured voltage to a current value (50 mV corresponding to 250 A). $\frac{\text{current}}{\text{voltage}} = \frac{250\ \text{A}}{50\ \text{mV}}$ If the voltage measured is 20.2 mV : $\text{measured current} = \frac{250\ \text{A}}{50\ \text{mV}} \times (20.2\ \text{mV}) = 101\ \text{A}$ Rotate the CUR CAL potentiometer on the display panel until this value is displayed.
4	Put the VOLT / AMP switch to VOLT. Adjust the V CAL potentiometer so that the reading displayed on the meter of the rectifier is identical to the reading on the digital meter.
5	Put the rectifier to OFF and reconnect the sense leads.
—end—	

6.4. Resetting the rectifier after an HVSD (high voltage shutdown)

To reset the rectifier after an HVSD condition has occurred execute one of the steps contained in Procedure 12.

Procedure 12 - Resetting the rectifier after a high voltage shutdown

Step	Action
Locally	
1	Toggle the ac circuit breaker on the unit itself, or the associated ac breaker in the distribution panel OFF and ON (wait until the green ac ON LED extinguishes before toggling the breaker back to ON).
Remotely	
2	Apply a ground signal at the HVSDR input of the rectifier.
—end—	

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7. Troubleshooting

Table 16 - Diagnosing system faults

Fault symptom	Possible causes
The RFA LED is lit.	• No ac input or input is out of bounds (ac ON LED is extinguished). • AC Input / dc output circuit breaker is open. • The rectifier has received an HVSD signal from the controller, or a TR signal is present. • An internal high voltage shutdown (HVSD) has occurred. • Two cooling fans or fuses have failed. • The inrush fuse has blown. • The dc circuit breaker is open. • A thermal shutdown has occurred. • Ambient air temperature is high. • Air inlet / outlet air is blocked, or the air filter is clogged. • A rectifier is in 'Start Time Delay' mode and the RFA will cease when the required time delay has elapsed. • Defective rectifier.
The HVSD LED is lit.	• The internal high voltage shutdown point is set to low (below the float or equalize setting). • The controller triggered a remote HVSD.

–**continued**–

Table 16 – Diagnosing system faults

Fault symptom	Possible causes
The AC ON LED is not lit.	• No ac input voltage. • The input circuit breaker is open. • AC voltage is present but is out of operational limits. The unit will restart when the ac returns to the operating level**.** • AC has just been applied and the rectifier will momentarily start (after an inrush control delay).
The FAN ALM LED is lit.	• The fuse of one or both fans has blown. • One or both fans have failed. ***Note 1 :*** If a single fan failed or a fuse blew, the rectifier will continue to operate while triggering a local and remote FAN ALM. ***Note 2 :*** If two cascaded fans failed or both fuses blew, the rectifier will shut down and trigger local and remote RFA alarms.
The SEN FAIL LED is lit.	• One, or both, remote sense leads is disconnected. • Excessive impedance in one or both sense leads. • The dc circuit breaker is open but the unit is in remote sense.
The CL LED is lit.	• The output load requirement exceeds the total rectifier capacity. • With paralleled units, the float or equalize is maladjusted causing one or more units to carry the load. • The unit is in "equalize" mode and paralleled units are not. • The remote sense lead has excessive impedance on one or more rectifiers. • The system batteries are in recharge mode after an ac outage. • The current share mode selection is not the same for all units. • The forced share line is disconnected (in FLS only).
—end—	

8. Appendix A : Replacement parts

ITEM	PART NUMBER (CPC)
Fan Assembly	P0723582
Fuse 1 A (FF1, FF2 on Display PCB)	A0287301
Air filter	P0744757
Air filter frame	P0744559

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9. Appendix B : Technical service assistance

For technical assistance, 24 hours a day / 7 days a week, dial one of the following toll-free numbers. This service complements the services offered by field support organizations such as, the Emergency Technical Assistance Service (ETAS), and the Installation Technical Assistance Service (ITAS).

9.1. Local toll-free prefixes

The following prefixes give access to toll-free numbers in various countries. For further information, please contact the local service provider.

Country	Prefix
Australia	0011
Belgium	00
Brazil	000815
Denmark	00
Finland	00 or 990
France	00
Germany	00
Hong Kong	001
Ireland	00
Japan	001 (KDD) 041 (ITJ) 0061 (Idc)
Korea	001(Korea Telecom) 002 (Dacom) 003 (Once)
Malaysia	00
Netherlands	00
New Zealand	00
Singapor	001
Switzerland	00
United Kingdom	00

9.2. Toll-free technical assistance numbers

United States:	1-800-992-8417	**Canada:**	1-800-363-2288
In Europe:		**In Asia and the Pacific:**	
Austria	800-213-49156	Australia	800-213-49156
Belgium	800-213-49156	Hong Kong	800-213-49156
Denmark	800-213-49156	Japan	800-213-49156
Finland	800-213-49156	Malaysia	800-213-49156
France	800-213-49156	New Zealand	800-213-49156
Germany	800-213-49156	Philippines	1-800-1-110-0131
Ireland	800-213-49156	Singapore	800-213-49156
Italy	800-213-49156	South Korea	800-213-49156
Netherlands	800-213-49156	Taiwan	800-213-49156
Norway	800-213-49156		
Sweden	800-213-49156		
Switzerland	800-213-49156		
United Kingdom [*1]	800-213-49156		
In the Caribbean and Latin America (CALA):		**In the Middle-East:**	
Bahamas	1-800-389-0081	Israel	800-213-49156
Barbados	1-800-534-0225		
Brazil	7101-2288		
Colombia	980-192288		
Dominican Republic	1-888-7514232		
Jamaica	1-800-850-1755		
Mexico	001-800-514-2288		
Puerto Rico	1-888-680-2288		
Trinidad & Tobago	1-800-363-2288		

[*1] The United Kingdom includes England, Guernsey, the Isle of Man, Jersey, Northern Ireland, and Scotland.

Note : For countries not covered by a toll-free service dial Canada (country code 001) at 514-832-0201.

10. Abbreviations and acronyms

ALCO	Alarm cut-off
ALM	Alarm
AUTOST	Auto restart Indicator
C	Common
CL	Current limit indicator
EMI	Electromagnetic interference
EQL	Equalize
FAN ALM	Fan alarm
HVSD	High voltage shutdown
HVSDR	High voltage shutdown reset
LED	Light Emitting Diode
LOP	Loss of phase
MPR	Modular power rectifier
NC	Normally closed
NO	Normally open
PCB	Printed circuit board
RC–	Remote charge bus (negative)

RFA	Rectifier fail alarm
RG+	Remote ground bus (positive)
RMT ACK	Remote acknowledge
SEN FAIL	Sense fail
THSD	Thermal shutdown
TR	Temporary release
VCAL	Voltage reading calibration

Helios Modular Switch Mode Rectifier

200I/48—NT5C05C

Installation and User Manual

Emerson Energy Systems
2280 Alfred-Nobel Blvd
St-Laurent (Quebec) Canada
H4S 2A4

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